A new species of *Neruda* Turner, 1976 from northeast Brazil (Lepidoptera: Nymphalidae, Heliconiinae, Heliconiini)

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Abstract: A new species of passion vine butterfly, *Neruda* ***metis* sp. n.,** from Serra do Penitente, Balsas municipality, Maranhão state, Brazil, is described and illustrated. Integumentary ultrastructural characteristics of the genitalia of both sexes are compared with the congeneric species. *N. metis* sp. n. general colour pattern resembles the *erato*-like "dennis-ray" subspecies of *N. aoede* (Hübner, [1813]), differing from these by having the outer margin of the hindwing with paired, conspicuous white spots located within each cell, and the forewing with two oblique, median yellow bands, instead of a yellow ring formed in the latter, among other differences in the male and female genitalia. The female holotype is deposited in the collection Padre Jesus S. Moure, Departamento de Zoologia, Universidade Federal do Paraná, Curitiba, Paraná, Brazil.

Key words: heliconian butterflies, Neotropical region, taxonomy.

Eine neue Art der Gattung *Neruda* Turner, 1976 aus Nordostbrasilien (Lepidoptera: Nymphalidae, Heliconiinae, Heliconiini)

Zusammenfassung: Eine neue Art von Passionsblumenfaltern, *Neruda* ***metis* sp. n.,** aus der Serra do Penitente, Balsas, Maranhão, Brasilien, wird beschrieben und abgebildet. Valvenmorphologie und Oberflächenultrastruktur der Genitalorgane von Männchen und Weibchen werden mit verwandten Arten verglichen. Das Farbmuster von *N. metis* sp. n. erinnert an die *erato*-ähnlichen Unterarten von *Neruda aoede* (Hübner, [1813]) mit strahlenförmiger Zeichnung, unterscheidet sich jedoch von diesen durch je zwei weiße randnahe Flecken in den Zellen des Hinterflügelhinterrands sowie auf dem Vorderflügel zwei schräge gelbliche Bänder anstelle einer gelblichen Ringzeichnung, dazu Unterschiede im männlichen und weibliche Genitalapparat. Der weibliche Holotypus befindet sich in der Sammlung von Padre Jesus S. Moure, Departamento de Zoologia, Universidade Federal do Paraná, Curitiba, Paraná, Brasilien.

Uma espécie nova de *Neruda* Turner, 1976 do nordeste brasileiro (Lepidoptera: Nymphalidae, Heliconiinae, Heliconiini)

Resumo: *Neruda* ***metis* sp. n.,** da Serra do Penitente, município de Balsas, Maranhão, Brasil, é descrita e ilustrada. São apresentadas características da ultraestrutura tegumentar da genitália de ambos os sexos e comparadas às espécies congenéricas. O padrão de coloração de *Neruda metis* sp. n. é similar às subespécies de *N. aoede* (Hübner, [1813]), do tipo "*erato*", diferindo delas por apresentar a borda externa da asa posterior com um par de manchas brancas arredondadas conspícuas em cada célula, e duas bandas amarelas, oblíquas, em posição mediana nas asas anteriores, ao invés de um anel formado naquelas, dentre outras diferenças nas genitálias feminina e masculina. O holótipo fêmea está depositado na coleção Padre Jesus S. Moure, Departamento de Zoologia, Universidade Federal do Paraná, Brasil.

Introduction

According to Lamas (2004), *Neruda* Turner, 1976 is known from only 3 species: *N. aoede* (Hübner, [1813]), *N. metharme* (Erichson, [1849]), and *N. godmani* (Staudinger, 1882). The latter is a monomorphic species found only in western Colombia. The 3 subspecies of *N. metharme* occur from Central America to northern Brazil and northern Peru. The 14 subspecies of *N. aoede* are distributed in northern South America, including parts of northern Brazil, the Guyanas, Venezuela, Ecuador, Peru, and Bolivia (Brown 1979, Holzinger & Holzinger 1994, Lamas 2004). *Neruda* was originally proposed by Turner (1976), as a subgenus of *Heliconius* Kluk, 1780, to separate species that share the following characters: short antennae, half the length of the forewing; forewing broadly triangular; male hindwing with modified scales on the costal margin, reaching or expanded into the discal cell; and abdominal segments with a pair of large rounded yellow spots, located above the yellow separating lines. Brown (1981) followed the criteria established by Turner (1976) and assigned generic status to *Neruda*, and also justified its monophyly in comparison to the related genera *Eueides* Hübner, 1816, *Laparus* Billberg, 1820, and *Heliconius*. The genus has been treated as a stable taxon ever since (e.g., D'Abrera 1984, Holzinger & Holzinger 1994, Penz 1999, Lamas 2004).

Thus, more than a century has passed without the discovery of a new species in this lineage of passion vine butterflies. This is not surprising, because the heliconian butterflies are among the best-known insects in the Neotropics (Brown 1981). Their adults have been intensively collected, and most of their alpha taxonomy has been worked out during the last two centuries (Penz 1999). Despite their popularity, however, additional heliconian species should be discovered eventually (Lamas 2004), most likely in areas where butterflies in general have been historically less collected.

Here, we describe a new species of *Neruda* from the northern area of the Cerrado (savanna), a major Brazilian continental biome (for description, see Oliveira & Marquis 2002; for maps, see IBGE 2004), where butterflies have been less intensively collected. Similarly to other areas of Brazilian savanna that have been largely neglected from a conservation perspective (Overbeck et al. 2007), the northern Cerrado is currently under strong pressure from agricultural expansion. Santos et al. (2008) suggested that Brazilian authorities should give priority to this region, not only for butterfly surveys but also for

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establishing conservation policies for these insects. Thus, by making formally available the name of a new species of *Neruda* from this region, we expect also to contribute indirectly to justify the establishment of such policies.

In addition to generic features of colour and morphology, integumentary characteristics of key genital structures of *Neruda metis* sp. n. are compared to its congeneric species.

Collection abbreviations:

EF	Coll. E. Furtado, Diamantino, Mato Grosso, Brazil.
CGCM	Coll. Carlos G. C. Mielke, Curitiba, Paraná, Brazil.
MNRJ	Coll. Museu Nacional, Rio de Janeiro, Brazil.
DZUP	Coll. Padre Jesus S. Moure, Departamento de Zoologia, Universidade Federal do Paraná, Curitiba, Paraná, Brazil.

Other abbreviations:

HT	holotype.
PT	paratype.
FW	forewing.
HW	hindwing.

Neruda metis sp. n.

Figs. 1a, 1b, 2a, 2b, 3a, 3b, 4a, 4b, 7, 11, 15, 19, 23a, 23b.

Holotype ♀ with the following labels: "24.–25. x. 2003, Serra do Penitente, 500 m, Balsas, MA, Brasil. C. Mielke leg.", "8.322 Col. C. Mielke", "DZ 15.808". Donated by the coauthor and deposited in DZUP. Figs. 1a, 1b, 7.

Paratypes (2 ♂♂, 3 ♀♀; all from the same locality and collector as the HT): 1 ♂, 24.–25. x. 2003 (CGCM 8.019, genitalia prep. 50-01 G. R. P. Moreira, Figs. 2a, 2b, 3a, 3b, 11, 15, 19); 1 ♂, 6. xi. 2004 (CGCM 23.642); 1 ♀, 24.–25. x. 2003 (CGCM 8.289, genitalia prep. 50-02 G. R. P. Moreira, Figs. 4a, 4b, 23a, 23b); 1 ♀, 15. xi. 2003 (CGCM 9.187); 1 ♀, 5.–6. xi. 2005 (EF 15.366).

Etymology. *Neruda metis* sp n. is named after Metis, a satellite of Jupiter. In Greek mythology, Metis was the first wife of Zeus (the Roman Jupiter) and the mother of Athena.

Other specimens examined:

***N. aoede* (Brazil): Amazonas:** Tonantins, vii. 1984, Silva leg., 2 ♂♂ (CGCM 18.436, 18.836); 1 ♀ (CGCM 18.884); 1 ♀ (CGCM 18.981, genitalia prep. 50-06 G. R. P. Moreira, Figs. 8, 24a, 24b). — **Pará:** Humaitá, 10. ix. 1978, Gifford leg., 1 ♂ (DZ 3.824, "ex coleção Gifford", genitalia prep. 38-24 C. M. Penz, Fig. 20). — **Rondônia:** Ouro Preto d'Oeste, 8.–14. xi. 1987, "Projeto Polo Noroeste", C. Elias leg., 1 ♂ (DZ 16.500, genitalia prep. 50-07 G. R. P. Moreira, Figs. 12, 16); Pimenta Bueno, Riozinho, 8. xi. 1972, 200 m, Mielke & Brown leg., 1 ♂ (DZ 16.507).

***N. godmani* (Colombia): West-Columbion,** 500 m, iii.–vi. 1927, Coleção Julius Arp, 1 ♂ (MNRJ 15/672, genitalia prep. 50-04 G. R. P. Moreira, Figs. 9, 13, 17); Antioquia, Rio Claro, 2. i. 1985, J. Salazar leg., 1 ♀ (DZ 16.514, genitalia prep. 50-05 G. R. P. Moreira, Figs. 5, 21a, 21b).

***N. metharme* (Brazil): Amazonas:** Tonantins, VII. 1984, Silva leg., 2 ♂♂ (CGCM 19.029, 19.081). — **Rondônia:** Candeias do Jamari, Banho do Rio Preto, 1.–15. vii. 1996, O. Miers & C. Mielke leg., 1 ♂ (CGCM 9.357, genitalia prep. 50-03 G. R. P. Moreira, Fig. 6); 1 ♀ (CGCM 8.892); Pimenta Bueno, Riozinho, 9. xii. 1972, 200 m, Mielke & Brown leg., 1 ♂ (DZ 3.832, genitalia prep. 93-20 C. M. Penz, Figs. 10, 14, 18); Pimenta Bueno, vii. 1970, 1 ♀ (DZ 3.834, genitalia prep. 93-19 C. M. Penz, Figs. 22a, 22b).

Description

♀ (Figs. 1a, 1b): wingspan 55–66 mm (HT: 55 mm), forewing length 30–35 mm (HT: 30 mm). A typical member of *Neruda*, having antennae equal to half of forewing in length, and abdominal segments with pair of large rounded yellow spots, located above the yellow separating lines. Body ground-colour blackish-brown to black. FW triangular, as in the genus; dorsally with an orange-red dennis of 4 broad stripes, covering the inner proximal portions of cells Sc, discal cell, CuA_2–2A, and anal margin; first and second stripes faintly separated by the Sc and R black veins; 2 yellow obliquely transverse median bands: proximal band consisting of a streak along the C, an hourglass-shaped spot within the distal portion of the discal cell, and a subtrapezoidal spot in the proximal portion of CuA_1-CuA_2; distal band narrower and shorter, formed by a small streak along the cell R_1-R_2 and by 3 small spots on the proximal portions of cells M_1-M_2, M_2-M_3, and M_3-CuA_1; external margin formed by paired, faintly white spots within cells from R_4 to CuA_2. Ventrally similar, with dennis stripes less pronounced; but with pairs of white spots clearly on external margin; in CuA_2-1A+2A, they are fused and extend into the middle as a small streak. HW dorsally with anterior portion brown; an orange-red bar across in middle of discal cell; from M_1-M_2 to anal margin, 6 orange-red rays in middle of cells, not reaching outer margin of wing, that of M_1-M_2 mostly faint; marginal border (Fig. 7) formed of paired, conspicuously white spots within each cell from Rs-M_1 to anal margin, the latter two pairs fused. Ventrally similar, but with a nine-rayed appearance; augmented by a long orange-red streak on Rs-M_1, by an additional ray on R_2-R_3, and with that of M_1-M_2 conspicuous; also with narrow yellow stripe on proximal portion of anterior margin.

♀ genitalia (Fig. 4a): eighth segment with narrower tergum; posterior apophyses similar in size to height of papillae anales; paired signa (Fig. 4b) arched, formed from 4 to 5 lines of spines longitudinally, with distal end not reaching ductus bursa. Stink-clubs attached to lateral fold, dorsally on posterior margin of eighth sternum. Stalk shorter than height of papillae anales. Tip rounded and capitate (sensu Emsley 1984), with specialized scales like an inverted cone, having moderately divided apex (Figs. 23a, 23b).

♂ (Figs. 2a, 2b): wingspan 58 mm, forewing length 33 mm. Body ground-colour and wing pattern as in ♀, except for wider velvety brownish area on upper side; anterior portion of HW, where modified scales are expanded into the discal cell and proximal portion of the anterior margin of M_1-M_2, as in the genus.

♂ genitalia (Fig. 3a): phallus similar in length to valva; vesica bearing little-differentiated cornutus; juxta (Fig.

Figs. 1–2: *Neruda metis* sp. n. **Fig. 1:** HT ♀ dorsal (a), ventral (b). **Fig. 2:** PT ♂, dorsal (a), ventral (b). — Scale bars: 1 cm. — **Figs. 5–8:** HW posterior margin, dorsal view. **Fig. 5:** *N. godmani*. **Fig. 6:** *N. metharme*. **Fig. 7:** *Neruda metis* sp. n. (HT). **Fig. 8:** *N. aoede*. — Scale bars: 1 mm.

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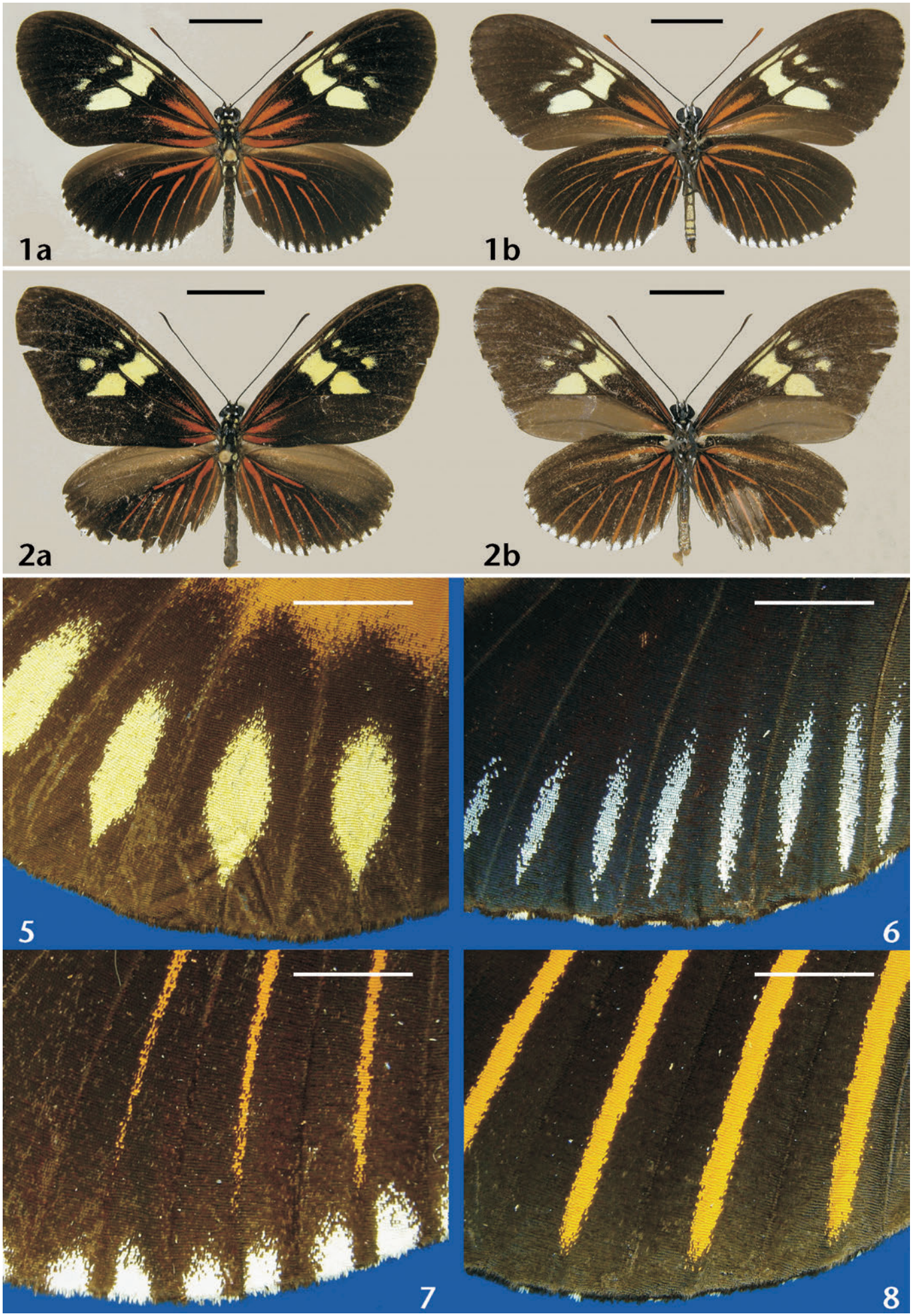

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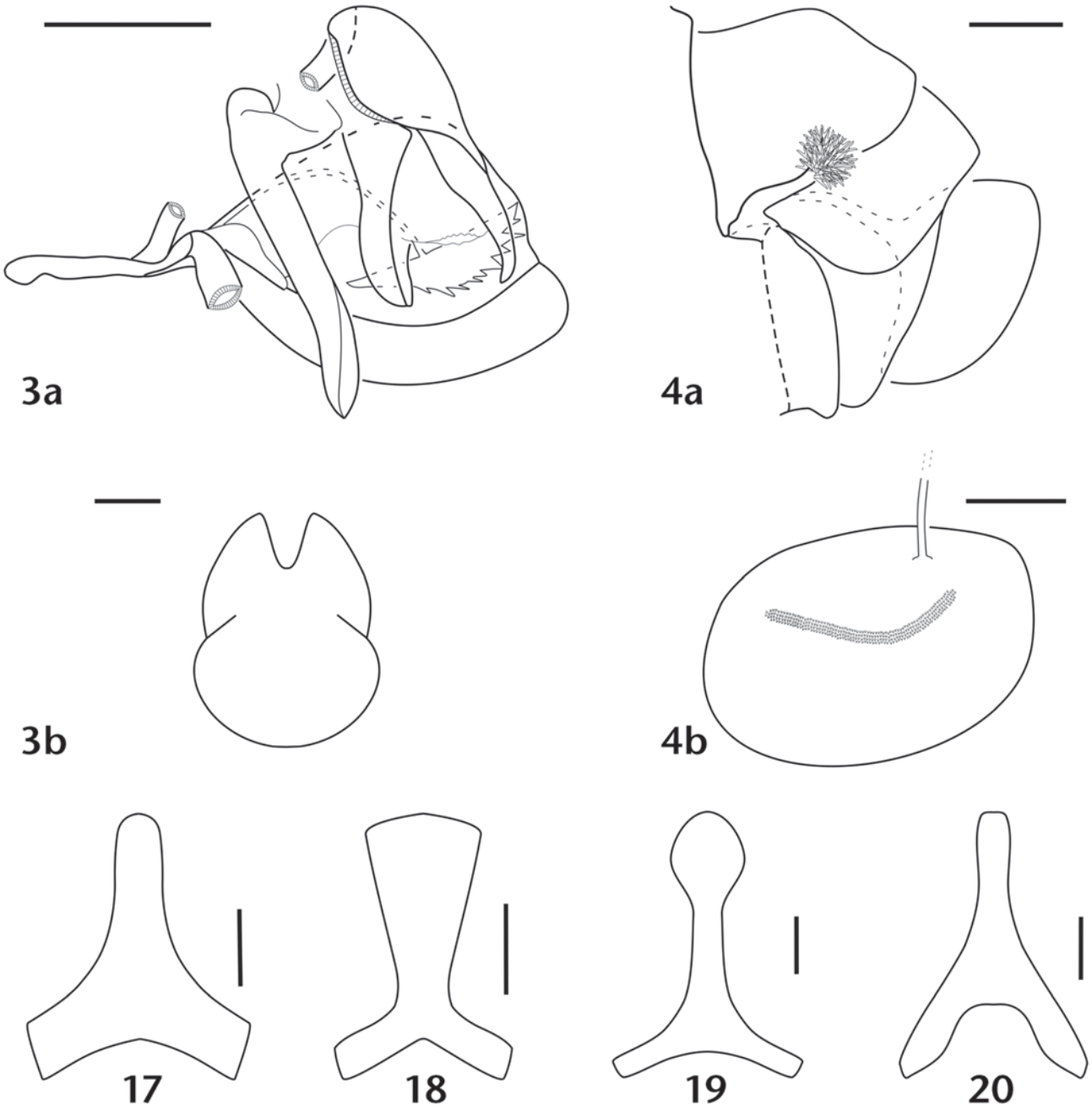

Figs. 3–4: *Neruda metis* sp. n. genitalia. **Fig. 3:** ♂ (PT): internal view (a), juxta posterior view (b). **Fig. 4:** ♀ (PT): external view (a), bursa copulatrix lateral view (b). — Scale bars: 1.0 mm (3a, 4b), 0.2 mm (3b), 0.4 mm (4a). — **Figs. 17–20:** Sacci, ventral view. **Fig. 17:** *N. godmani*. **Fig. 18:** *N. metharme*. **Fig. 19:** *N. metis* sp. n. (PT). **Fig. 20:** *N. aoede*. — Scale bars: 0.2 mm (16, 18), 0.5 mm (17), 0.3 mm (19).

3b) nearly straight longitudinally, with upper edge forked; valva (Fig. 11) rounded and subtriangular; costa with eversible pouch on its inner surface, bearing a crista median-ventrally; crista club-shaped, with apex reaching near dorsal margin of valve, and with large spines, these larger on ventral edge (Fig. 15); anterior process of saccus circa half of valva length, with capitate apex (Fig. 19).

Immature stages. Unknown.

Diagnosis

N. metis sp. n. resembles the *erato*-like "dennis-ray" subspecies of *N. aoede*, but the latter can be promptly distinguished by the absence of white spots on the HW margin (Fig. 8). They can also be distinguished by the yellow ring formed on the FW, rather than the 2 oblique bands present in *N. metis* sp. n. *N. metharme* differs markedly by the conspicuous dark iridescent blue colour on the FW dorsally, by the oblique transverse yellow bands, located not in the middle but in the proximal and distal portions of FW, separately; and by the marginal borders formed by doubled white streaks, rather than spots (Fig. 6). None of the above set of colour characteristics was found in the monomorphic *N. godmani*, which shows a distinct HW margin (Fig. 5).

Differences were also found in the genitalia. In the ♂, the phallus is similar in size to that of *N. aoede*, but it is smaller in *N. godmani* and *N. metharme* (circa two thirds of

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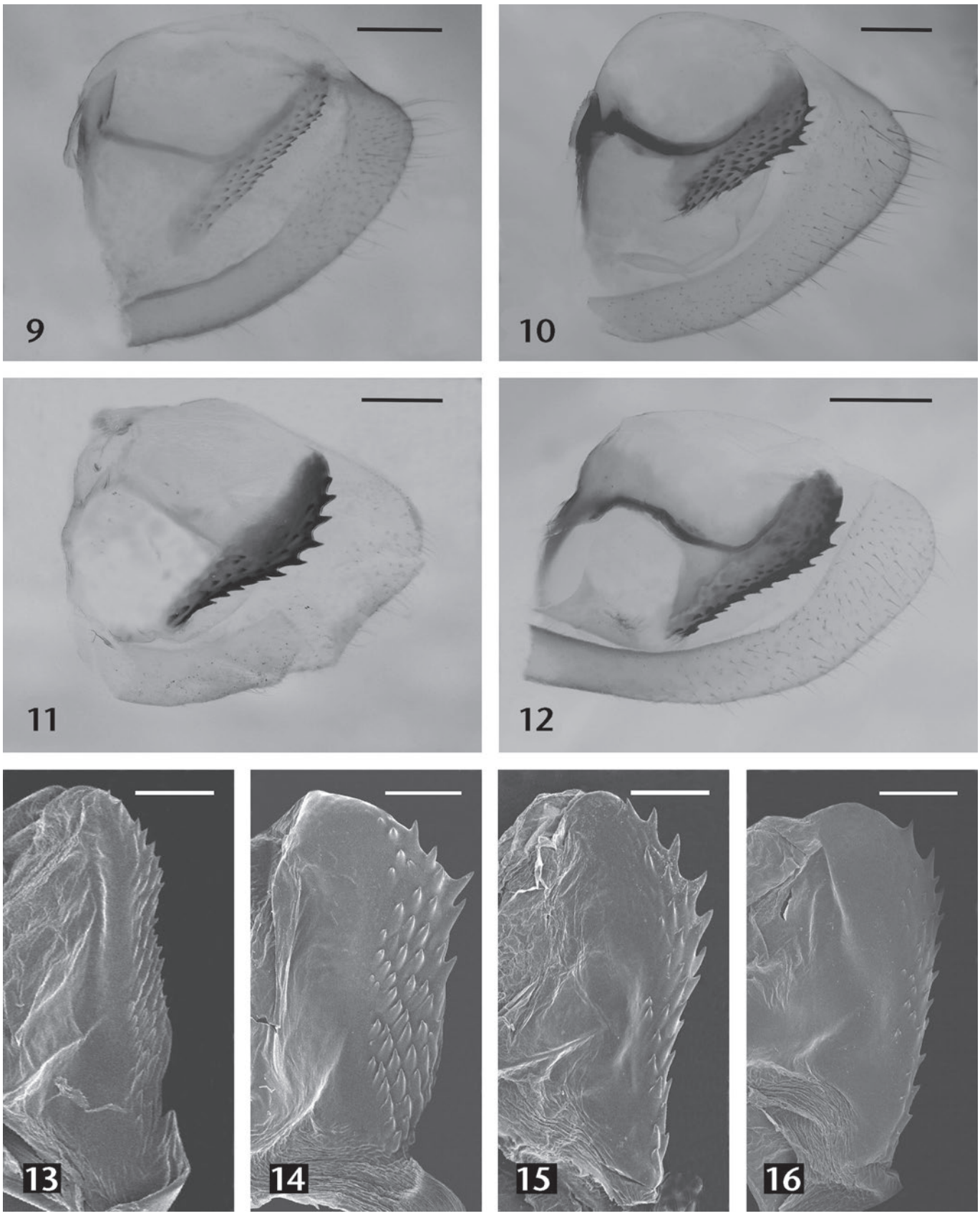

Figs. 9–12: Valvae under light microscopy, internal view. **Fig. 9:** *N. godmani*. **Fig. 10:** *N. metharme*. **Fig. 11:** *N. metis* sp. n. (PT). **Fig. 12:** *N. aoede*. — Scale bars: 0.5 mm. — **Figs. 13–16:** Valvular cristae under scanning electron microscopy, internal view. **Fig. 13:** *N. godmani*. **Fig. 14:** *N. metharme*. **Fig. 15:** *Neruda metis* sp. n. (HT). **Fig. 16:** *N. aoede*. — Scale bars: 250 µm (13), 200 µm (14, 15, 16).

the valve length, in both species). The crista of the valva in *N. aoede* (Fig. 16) has a convex posterior margin and smaller spines; that of *N. metharme* (Fig. 14) is subrectangular, and bears more spines than *N. metis* sp. n. and *N. aoede*; in *N. godmani* (Fig. 13), it differs in being narrower and straight, and by having smaller spines, compared to the other 3 species, a condition previously noted by Penz (1999). The capitate apex of the anterior process

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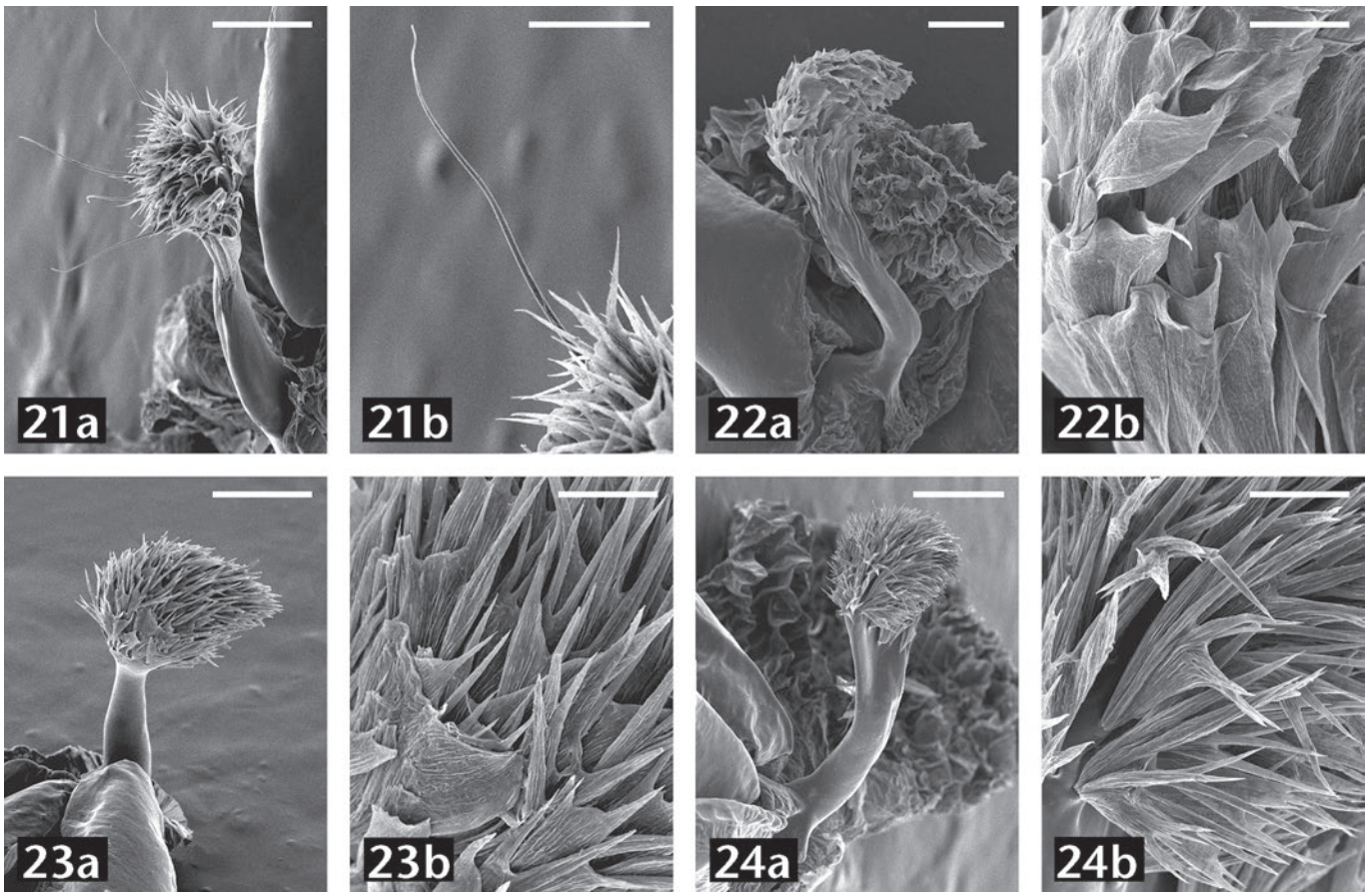

Figs. 21–24: Stink clubs under scanning electron microscopy, lateral view. **Fig. 21:** *N. godmani*, whole (**a**), detail (**b**). **Fig. 22:** *N. metharme*, whole (**a**), detail (**b**). **Fig. 23:** *Neruda metis* sp. n. (PT), whole (**a**), detail (**b**). **Fig. 24:** *N. aoede*, whole (**a**), detail (**b**). — Scale bars: 100 µm (20a, 21a, 22a, 23a), 20 µm (21b, 22b, 23b), 40 µm (20b).

of the saccus described for *N. metis* sp. n. is unique; it is spatulate in *N. metharme* (Fig. 18), and is tubular, with a blunt apex, in the other 2 species (Figs. 17, 20), being markedly smaller (less than a third of valva length) in *N. godmani*.

In the ♀, the stink-clubs of *N. metis* sp. n. are also alike; the stalk apex of the other species is not capitate and is similar in width to the stalk itself. In *N. aoede* (Figs. 24a, 24b), contrary to the condition observed in *N. metis* sp. n., the specialized scales are deeply divided; in *N. metharme* they are nearly blunt distally (Figs. 22a, 22b), differing in this regard from the other 3 species; in *N. godmani* (Figs. 21a, 21b), the stink-clubs are distinct in having conical specialised scales interspersed with filiform ones, a specialised scale type that up to now has only been found in the primitive heliconian genera *Agraulis* Boisduval & Le Conte, [1835], *Dione* Hübner, [1819], and *Podotricha* Michener, 1942 (Emsley 1963, Penz 1999).

Further remarks

Our findings indicate the existence of fine-scale character differences in genitalia structures, which should be taken into account in future studies involving the elucidation of the phylogenetic position of *Neruda* within Heliconiini. These differences suggest that *Neruda metis* sp. n. is more closely related to *N. aoede* than to *N. metharme* and *N. godmani*, relationships that should be better explored. Using combined characters of the adults of the 3 known species of *Neruda*, and the immatures of one species (*N. aoede*), Penz (1999) found strong support for the monophyly of *Neruda*, which came out in her analyses as the sister lineage of *Eueides*, in the *Laparus*, *Neruda*, and *Eueides* clade, the sister group of *Heliconius*. On the other hand, phylogenetic relationships inferred from multilocus DNA sequence data supplied by Béltran et al. (2007) indicated that *Heliconius* is paraphyletic with respect to *Neruda*, thus suggesting that the latter might be subsumed into the former. However, their results were not conclusive, having failed to reject the alternative hypothesis that *Neruda* is sister to *Heliconius*. Thus, as also suggested by these authors, we retain here the traditional nomenclature for the genus, until further evidence on the biology of *Neruda* and the phylogeny of *Heliconius* is available. We are now examining the stability of such differences in genitalia characteristics among populations, thus searching for additional information to aid in the understanding of the taxonomy and phylogeny of *Neruda*.

Geographical distribution. *Neruda metis* sp. n. is known only from the type locality. Other specimens were observed, but not collected, around the city of Balsas and also 30 km W of the city of Fortaleza dos Nogueiras, state of Maranhão.

Ethology. Unknown.

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Acknowledgments

We thank Dr. Olaf H. H. Mielke (Universidade Federal do Paraná, Curitiba, Brazil) for his help in obtaining material of *N. godmani* for the study, for the loan of specimens of *N. aoede* and *N. metharme* from the DZUP, and also for critically reading the first version of the manuscript. Thanks are also due Dr. Alexandre Soares (Museu Nacional, Rio de Janeiro) and Dr. Julian Adolfo Salazar (Centro de Museos de La Universidad de Caldas, Manizales, Colombia) for the loan and donation of specimens of *N. godmani*, respectively. Also, to Kim R. Barão and Denis S. Silva (Universidade Federal do Rio Grande do Sul, Porto Alegre, Brazil) for helping with editing the figures, and Janet W. Reid for revising the English text. Financial support for this study came in part from CNPq (Proj. No. 304458/2008-2, granted to G. R. P. Moreira).

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Received: 4. i. 2010

© Entomologischer Verein Apollo e. V., Frankfurt am Main, August 2010 ISSN 0723-9912

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